4.12 Temporary Sediment Basin

Sd3

Definition

A basin created by constructing a barrier or dam across a waterway or by excavating a basin or by a combination of both. A basin typically consists of a dam, a pipe outlet, and an emergency spillway. The size of the structure will depend upon the location, size of drainage area, soil type, and rainfall pattern.

Purpose

Sediment basins are used to detain runoff waters and trap sediment from erodible areas in order to protect properties and drainage ways below the installation from damage by excessive sedimentation and debris. The water is temporarily stored and the bulk of the sediment carried by the water is filtered and retained in the basin while the water is automatically released.

Conditions

This practice applies to critical areas where physical site conditions, construction schedules, or other restrictions preclude the installation or establishment of other erosion control practices to satisfactorily reduce runoff, erosion, and sedimentation. The structure may be used in combination with other practices and should remain in effect until the sediment-producing area is permanently stabilized.

This standard applies to the installation of temporary (to be removed within 12 months) sediment basins on sites where: (1) failure of the structure would not result in loss of life or interruption of use or service of public utilities, and (2) the drainage area does not exceed 50 acres.

Design Criteria for Temporary Sediment Basins

Compliance with Laws and Regulations

Design and construction must comply with state and local laws, ordinances, rules, and regulations and must be prepared by a registered professional engineer. The following information is provided for reference and to establish minimum norms. Temporary

sediment basins may be considered small dams and be subject to state regulations governing design and construction.

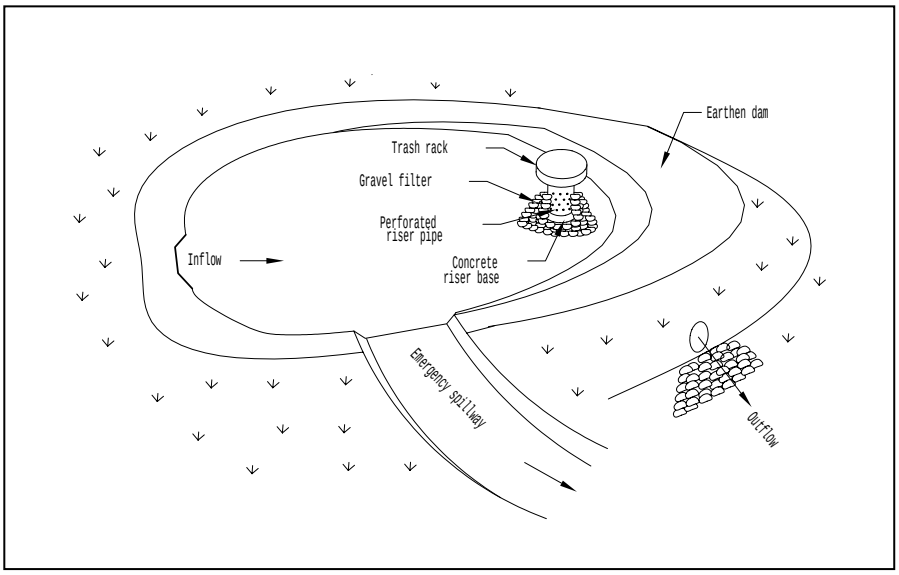

Figure 4.12.1 Components of a Typical Temporary Sediment Basin

Location

The sediment basin should be located to obtain the maximum storage benefit from the terrain and for ease of cleanout of the trapped sediment. It should also be located to minimize interference with construction activities and construction of utilities.

Sediment basins should be located so that storm drains discharge into the basin. They should never be placed in live streams.

Volume of the Basin

Ensure that the sediment storage volume of the basin, as measured to the elevation of the crest of the principal spillway, is at least 67 cubic yards per acre for the disturbed area draining into the basin (67 cubic yards is equivalent to ½ inch of sediment per acre of basin drainage area). Where possible, the entire drainage basin is used for this computation, rather than the disturbed area alone, to help ensure adequate trapping efficiency. Remove sediment from the basin when approximately one-third of the storage volume has been filled. This volume shall be marked on the riser or by setting a marked post near the riser.

Surface Area

The following relationship between surface area and peak inflow rate is to be maintained as a minimum to achieve adequate trapping efficiency. Certain soil types such as silty clays may require greater surface areas and longer travel times within the basin to be effective. Ultimately, the adequacy is measured against the quality of the discharge.

$$A = 0.01q$$

where A is basin surface area in acres and q is peak inflow rate in cfs. Area is measured at the crest of the principal spillway riser. The minimum peak inflow rate is determined from a 2-year, 24-hour storm.

Shape of the Basin

It is recommended that the design of a sediment basin incorporate features to maximize travel time of flow within the basin. Suggested methods of accomplishing this objective include:

1. Length to width ratio greater than 2:1, where length is the distance between the inlet and outlet.

2. A wedge shape with the inlet located at the narrow end.

3. Use of baffles and diversions to increase the flow length.

The dimensions necessary to obtain the required basin volume and surface area shall be clearly shown on the plans to facilitate plan review, construction, and inspection.

Spillways

Runoff computations shall be based upon the worst soil-cover conditions expected to prevail in the contributing drainage area during the anticipated effective life of the structure. The combined capacities of the principal and emergency spillway shall be sufficient to pass the peak rate of runoff for a 25-year, 24-hour frequency storm.

1. **Principal Spillway –** A spillway consisting of a vertical pipe or box-type riser joined (watertight connection) to a pipe, which shall extend through the embankment and outlet beyond the downstream toe of the fill shall be provided. The metal gauge thickness shall comply with DOT specifications. The discharge shall be based on a 2-year, 24-hour storm for the total drainage area without causing flow through the emergency spillway. The appropriate disturbed soil cover

condition shall be used. The minimum size of the pipe shall be 8 inches in diameter. Principal spillway capacities must be determined from calculations and provided. Weir flow discharge above the crest of the riser must be determined and calculations provided.

a. Crest Elevation – The crest elevation of the riser shall be a minimum of 1 foot below the elevation of the control section of the emergency spillway.

b. Watertight Barrel Assembly – The riser and all pipe connections shall be completely watertight except for the inlet opening at the top or dewatering openings, and shall not have any other holes, leaks, rips, or perforations.

c. Dewatering the Basin – Retention time within the basin is an important factor in effective sedimentation retention. Perforate the lower half of the riser with ½-inch holes spaced approximately 3 inches apart. Cover with 2 feet of ½- to ¾-inch aggregate, No. 57, or No. 5 clean stone.

d. Trash Rack and Anti-Vortex Device – A trash rack and anti-vortex device shall be securely installed on top of the riser and may be the type as shown in Figure 4.12.2.

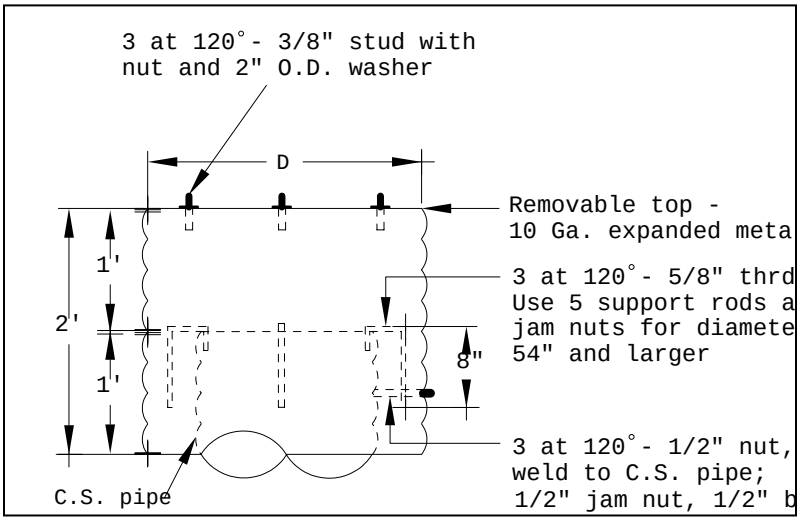

Figure 4.12.2 Typical Sediment Basin Trash Rack

e. Base – The riser shall have a base attached with a watertight connection and shall have sufficient weight to prevent flotation of the riser. An 18-inch-thick concrete base with the riser embedded 9 inches in the base is recommended.

Computations shall be made to design a base that will prevent flotation. The minimum factor of safety shall be 1.20 (downward forces – 1.20 x upward forces).

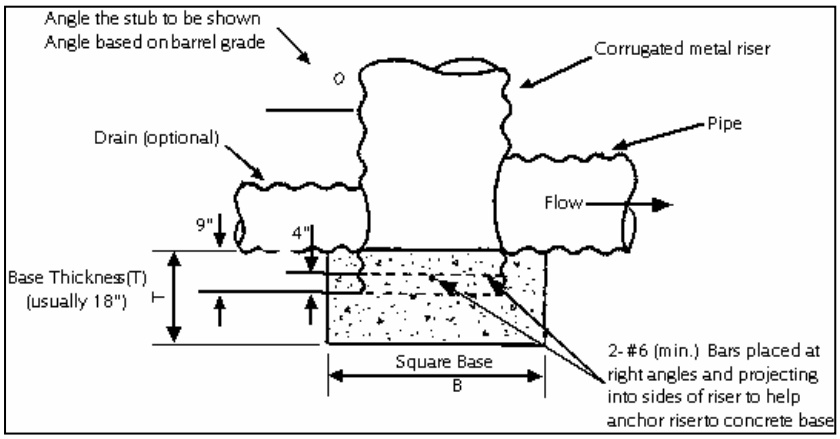

Figure 4.12.3 Concrete Riser Base Detail

f. Anti-Seep Collars – One anti-seep collar shall be installed around the pipe, near the center of the dam, when any of the following conditions exist:

- The settled height of the dam is greater than 12 feet.
- The conduit is smooth pipe larger than 8 inches in diameter.
- The conduit is corrugated metal pipe larger than 12 inches in diameter.

Use an anti-seep collar with an 18-inch projection for heads (H) less than or equal to 10 feet and a 24-inch projection for heads (H) greater than 10 feet. The anti-seep collar and its connection shall be watertight.

g. Outlet – An outlet shall be provided, including a means of conveying the discharge in an erosion-free manner to an existing stable channel. Where discharge occurs at the property line, drainage easements will be obtained in accordance with local ordinances. Adequate notes and references will be shown on the erosion and sediment control plan. Protection against scour at the discharge end of the pipe spillway shall be provided. Measures may include excavated plunge pools, riprap, impact basins, revetments, or other approved methods.

h. For typical features of a temporary sediment basin, see Figure 4.12.4.

2. **Emergency Spillway –** The entire flow area of the emergency spillway shall be constructed in undisturbed ground (not fill). The emergency spillway shall be designed by a registered professional engineer.

   a. Capacity – The minimum capacity of the emergency spillway shall be that required to pass the peak rate of runoff form the 25-year, 24-hour frequency storm, less any reduction due to flow in the principal spillway. The appropriate disturbed soil cover condition shall be used.

   b. Velocities – The velocity of flow in the exit channel shall not exceed 5 feet per second for vegetated channels. For channels with erosion protection other than vegetation, velocities shall be within the non-erosive range for the type of protection used.

   c. Erosion Protection – Vegetation, riprap, asphalt, or concrete shall be provided to prevent erosion.

   d. Freeboard – Freeboard is the difference between the design high water elevation in the emergency spillway and the top of the settled embankment. The freeboard shall be at least 1 foot.

Entrance of Runoff into Basin

Points of entrance of surface runoff into excavated sediment basins shall be protected to prevent erosion and sediment generation. Dikes, swales, or other water control devices shall be installed as necessary to direct runoff into the basin. Points of runoff entry should be located as far from the riser as possible to maximize travel time.

Construction Specifications

Site Preparation

Areas under the embankment and under structural works shall be cleared, grubbed, and stripped of topsoil. All trees, vegetation, roots, and other objectionable material shall be removed and disposed of by approved methods. To facilitate cleanout or restoration, the pool area (measured at the top of the pipe spillway) will be cleared of all brush and trees.

Cut-Off Trench

A cut-off trench will be excavated along the centerline of earth fill embankments. The minimum depth shall be 2 feet. The cut-off trench shall extend up both abutments to the riser crest elevation. The minimum bottom width shall be 4 feet and must be of adequate width to allow operation of compaction equipment. The side slopes shall be no steeper than 1:1. Compaction requirements shall be the same as those for the embankment. The trench shall be drained during the backfilling and compaction operations.

Embankment

Fill material shall be taken from approved areas shown on the plans. It shall be clean mineral soil free of roots, woody vegetation, oversized stones, rocks, or other objectionable materials. Relatively pervious materials such as sand or gravel shall be placed in the downstream section of the embankment. Areas where fill is to be placed shall be scarified prior to fill placement. The fill material shall contain sufficient moisture so it can be formed by hand into a ball without crumbling. If water can be squeezed from the ball, the fill is too wet for proper compaction. Fill material shall be placed in 6- to 8-inch-thick continuous layers over the entire length of the fill. Compaction shall be obtained by routing and hauling the construction equipment over the fill so that the entire surface of the fill is traversed by at least one wheel or tread track of the equipment or by use of a compactor. The embankment shall be constructed to an elevation 5 percent higher than the design height to allow for settlement.

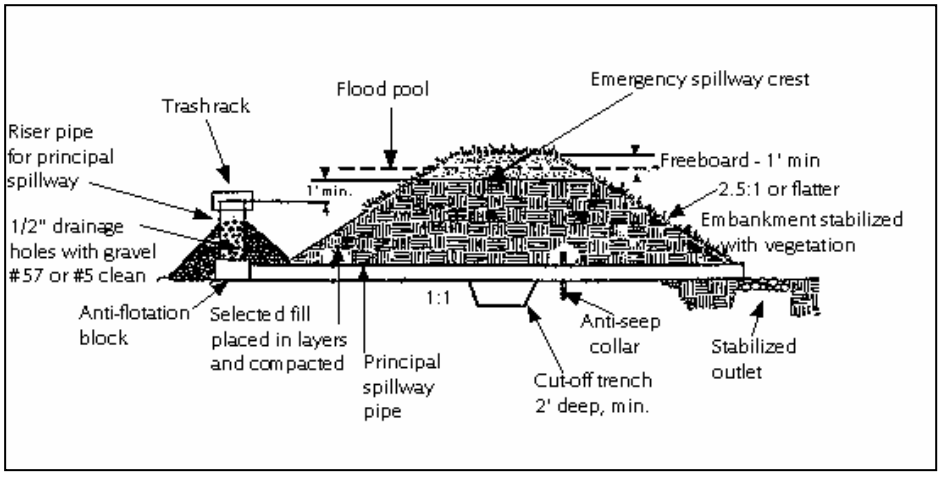

Figure 4.12.4 Section Through Embankment and Typical Features

Principal Spillway

The riser shall be securely attached to the pipe or pipe stub by welding the full circumference, making a watertight structural connection. The pipe stub must be attached to the riser at the same percent (angle) of grade as the outlet conduit. The connection between the riser and the riser base shall be achieved by approved watertight bank assemblies. The pipe and riser shall be placed on a firm, smooth foundation of impervious soil as the embankment is constructed. Breaching the embankment is unacceptable. Pervious materials such as sand, gravel, or crushed stone shall not be used as backfill around the pipe or anti-seep collar. The fill material around the pipe spillway shall be placed in 4-inch layers and compacted under and around the pipe to at least the same density as the adjacent embankment. Care must be taken not to raise the pipe from firm contact with its foundation when compacting under the pipe haunches. A minimum depth of 2 feet of hand-compacted backfill shall be placed over the pipe spillway before crossing the spillway with construction equipment.

Emergency Spillway

The emergency spillway shall be installed in undisturbed ground. Planned elevations, grades, design width, and entrance and exit channel slopes are critical to the successful operation of the emergency spillway and must be constructed within a tolerance of 0.1 foot.

Vegetative Treatment

Stabilize the embankment and all other disturbed areas in accordance with the appropriate permanent vegetative measure, Ds3, immediately following construction. In no case shall the embankment remain unstabilized for more than 7 days.

Erosion and Pollution Control

Construction operations will be executed in a manner that erosion and water pollution will be minimized. Compliance with state and local law concerning pollution abatement shall be maintained.

Safety

State and local requirements shall be met concerning fencing and signs to warn the public of hazards of soft sediment and floodwater.

Maintenance

All damages caused by soil erosion or construction equipment must be repaired at the end of each working day. Sediment shall be removed from the basin when it reaches

the specified distance below the top of the riser. Removed sediment shall be placed and stabilized in such a manner that it will not erode from the site. The sediment shall not be deposited downstream from the embankment or adjacent to a stream or floodplain.

Final Disposal

When temporary structures have served the intended purpose and the contributing drainage area has been properly stabilized, the embankment and resulting sediment deposits are to be leveled or otherwise disposed of in accordance with an approved sediment control plan. The proposed use of a sediment basin site will often dictate final disposition of the basin and any sediment contained therein. If the site is scheduled for future construction, the embankment and trapped sediment must be removed, safely disposed of, and backfilled with a structural fill. When the basin area is to remain open space, the pond may be pumped dry, graded, and backfilled.

Submittal Information

Sediment basin designs and construction plans submitted for review shall include the following:

1. Specific location of the basin.

2. Plan view of the storage basin and emergency spillway showing existing and proposed contours.

3. Cross-section of dam, principal spillway, and emergency spillway, and profile of emergency spillway.

4. Details of pipe connections, riser to pipe connections, riser base, anti-seep collars, trash rack, cleanout elevation, and anti-vortex device.

5. Runoff calculations for the 2-year frequency principal spillway storm and the disturbed condition 25-year frequency emergency spillway storm.

6. Storage computations

    a. Total required

    b. Total available

c. Level of sediment at which cleanout shall be required shall be stated as distance from the riser crest to the sediment surface.

7. Calculations showing design of pipe and emergency spillway.

8. Maintenance equipment access points.

9. The seal of a registered professional engineer.

Temporary Sediment Basin Design Data Sheet

The following information, specification, and calculation data is to be supplied with the Erosion and Pollution Control Plan for a temporary sediment design submittal:

1. The minimum required volume of storage is 67 cubic yards per acre for each acre of disturbed drainage area, although when possible, the total drainage area should be used. Volume should be computed form contour information. A stage-storage curve should be developed for the site showing elevation versus accumulated volume. The contour map is used to measure areas for various contour intervals from the basin bottom to the expected top of dam elevation. The storage volume within the basin is usually natural storage and storage gained from excavated soil that will be used for construction of the dam.

2. The volume of the basin for cleanout of sediment is 22 cubic yards per acre for each acre of drainage area. As the basin fills with sediment to this volume, the sediment shall be removed to restore the original design volume.

3. Determine the design elevation for the minimum required storage volume of the basin. The design elevation is set at the principal spillway riser crest to provide the required 67 cubic yards per acre of drainage area.

4. Determine the design elevation of the sediment cleanout pool level. The basin shall be dewatered to this elevation using perforations in the riser pipe. This design elevation corresponds to the 22 cubic yards per acre.

5. Determine the distance of basin cleanout below the riser crest. The cleanout elevation shall be clearly marked on the riser or by use of a marked post near the riser.

6. Compute the peak discharge rates (for the 2-year and 25-year, 24-hour storm events) for the principal and emergency spillways using accepted engineering practices. The worst disturbed land-use condition shall be used.

7. Determine the value of "H", the vertical distance between the centerline of the outlet pipe and the emergency spillway crest. Determine the pipe length.

8. Determine the pipe diameter and Q_{PS} to pass the 2-year peak discharge (Q_2).

9. Determine the riser diameter and elevation and provide a minimum of 1-foot freeboard to the emergency spillway elevation.

10. Determine the trash rack anti-vortex device size.

11. Compute the emergency spillway capacity (Q_{ES}) by subtracting the actual flow carried by the principal spillway from Q_{25}.

12. Determine the emergency spillway entrance channel slope, exit channels slope, bottom width, and flow stage values.

13. Specify an anti-seep collar, if required.

14. Determine the design elevations of the riser crest, emergency spillway, design high water, and the top of the dam.

15. Determine the minimum surface area required.